Pharmacokinetics Practice Problems

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Mr. Jones is admitted to General Hospital with a gram-negative bacteria. The antibiotic tobramycin is ordered. The CL and Vd of tobramycin in Mr. Jones are 80 mL/min and 40 L, respectively.
What maintenance dose should be administered intravenously every 6 hours to eventually obtain average steady state plasma concentrations of 4 mg/L?

A. 0.32 mg
B. 19.2 mg
C. 115 mg
D. 160 mg
E. 230 mg

Cl = 80 ml = 0.080 L

Bioavailability = f

$$\text{Maintenance Dose} = \frac{CP_{ss} \bullet CL}{\text{Bioavailability}}$$

$$\text{M.D.} = \frac{4 \text{ mg}/\cancel{\text{L}} \bullet 0.080 \cancel{\text{L}}/\text{min}}{1.0}$$

M.D. = 0.32 mg/min

Conversion of Units Needed:

M.D. = 0.32 mg / ~~min~~ • 60 ~~min~~ / ~~hr~~ • 6 ~~hrs~~

M.D. = 115 mg

If you wish to give Mr. Jones an IV loading dose to achieve the therapeutic plasma concentration of 4 mg/L rapidly, how much should be given?

A. 0.1 mg
B. 10 mg
C. 115.2 mg
D. 160 mg
E. None of the above

$$LD = \frac{Css \times Vd}{Bioavailability}$$

$$LD = \frac{4\ mg / L \times 40\ L}{1}$$

$$LD = 160\ mg$$

A normal volunteer will receive a new drug in a phase I clinical trial. The clearance and volume of distribution of the drug in this subject are 1.386 L/h and 80 L, respectively. The half-life in this subject will be approximately

A. 83 hours
B. 77 hours
C. 58 hours
D. 40 hours
E. 0.02 hours

$CL = 1.386\ L / hr$

$V_d = 80\ L$

$$t½ = \frac{V_d \times 0.693}{CL}$$

$$t½ = \frac{80\ L \times 0.693}{1.386\ L / hr}$$

$$t½ = 40\ hrs.$$

If 25 mg of a drug is administered and the plasma concentration is 1 mg/L, what is the Vd (volume into which a drug is distributed)?

$$Vd = \frac{Dose}{Cp}$$

$$Vd = \frac{25\ mg}{1\ mg / L} = 25\ L$$

A target plasma theophylline concentration of 10 mg/L is desired to relieve bronchial asthma in a patient. The Vd for theophylline is 35 L. What is the loading dose (amount of drug needed to achieve a desired plasma concentration)?

$$\text{Loading Dose} = \frac{\text{Css} \times \text{Vd}}{\text{Bioavailability}}$$

LD = 10 mg /~~L~~ x 35 ~~L~~

LD = 350 mg

Pharmacokinetic characteristics of propranolol include Vd = 300 L/70 kg, CL = 700 ml/min, oral bioavailability f = 0.25. What is the dose needed to achieve a plasma level equivalent to a steady-state level of 20 μg/L?

A. 4 mg
B. 8 mg
C. 12 mg
D. 24 mg
E. 48 mg

$$\text{Loading Dose} = \frac{Cp_{ss} \times Vd}{\text{Bioavailability}}$$

$$20\ \mu g / L = 0.020\ mg / L$$

$$LD = \frac{0.020\ mg/L \times 300\ L}{0.25}$$

$$LD = 24\ mg$$

What is the approximate percentage of a weak acid (pKa = 5.4) in the non-ionized form in plasma having a pH of 7.4?

A. 99%
B. 90%
C. 10%
D. 1%
E. 0.1%

$$\log \frac{[HA]}{[A^-]} = pKa - pH$$

$$\log \frac{[HA]}{[A^-]} = 5.4 - 7.4$$

$$\log \frac{[HA]}{[A^-]} = -2$$

Antilog of -2 = 0.01

$$\text{So, } \frac{[HA]}{[A^-]} = \frac{0.01}{1} = \frac{1}{100}$$

Most of the drug is in an ionized (charged) form at this pH, so it won't be readily absorbed.